

Remarks

Reconsideration of the subject application is requested in view of the following amendments and remarks. Claims 1-5, 7-21, and 75-107 are pending. By this Amendment, claims 16 and 90 have been amended. All other pending claims are unchanged.

I. Allowable Subject Matter

The allowance of claims 1-5, 7-15, 18, 21, and 75-103 is acknowledged with thanks.

II. 35 U.S.C. § 102(b) Rejection of Claims 16 and 17

Claims 16 and 17 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by PCT Publication No. WO 94/18433 to Ohio University (the "Ohio reference"). Applicants traverse this rejection and request that it be withdrawn.

Claim 16 is directed to a structure having a plurality of micro-transducers. The structure comprises a first major layer, a second major layer juxtaposed to the first layer, a plurality of fluid-tight cavities cooperatively formed between the first and second major layers, a working fluid contained in the cavities, a plurality of first electrodes carried by the first major layer at each of said cavities, a plurality of piezoelectric members carried by the first electrodes at each of said cavities, and a plurality of second electrodes carried by the piezoelectric members at each of said cavities. Claim 16 also recites that the first electrodes comprise a unitary first metallic layer overlaying the first surface, the plurality of piezoelectric members comprise a unitary piezoelectric layer overlaying the first metallic layer, and the plurality of second electrodes comprise a unitary second metallic layer overlaying the piezoelectric layer.

The Ohio reference is understood to disclose an apparatus that comprises a plurality of coolers disposed between an upper and lower substrate 14 and 22, respectively. See page 8, lines 14-17 and FIG. 1. Each cooler has an expansion diaphragm 34 that supports an actuator 35 and a compression diaphragm 44 that supports an actuator 45. See page 9, lines 4-28 and FIG. 5. As shown in FIG. 5A, the actuator 45 comprises a piezoelectric layer 522, a plurality of electrodes 510, 512, 514 mounted to the bottom of the piezoelectric layer 522, and a plurality of electrodes 516, 518, 520 mounted to the top of the piezoelectric layer 522. See page 23, lines 26-33. In addition, the actuator 45 is covered by an oxide layer 528 (FIG. 5A) that separates the actuator from the actuators of the other coolers formed between the upper and lower substrates. See page 24, lines 10-12.

In contrast to claim 16, each cooler in the Ohio reference has a discrete piezoelectric layer 522, a discrete set of upper electrodes 516-520, and a discrete set of lower electrodes 510-514. The respective electrodes and piezoelectric layer of a particular cooler are separate from the piezoelectric layers and electrodes of adjacent coolers. Thus, the sets of upper electrodes do not (and cannot) form a respective unitary metallic layer as claimed, the sets of lower electrodes do not (and cannot) form a respective unitary metallic layer as claimed, and the piezoelectric layers 522 do not (and cannot) form a unitary piezoelectric layer as claimed.

For the foregoing reasons, claim 16 is not anticipated or rendered obvious by the Ohio reference and is allowable.

Claim 17 depends from claim 16 and is allowable for the reasons given above in support of claim 16 and further because claim 17 sets forth an independently patentable combination of features.

III. 35 U.S.C. § 102(b) Rejection of Claims 16, 17, and 19

Claims 16, 17, and 19 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 4,140,936 to Bullock (Bullock). Applicants traverse this rejection and request that it be withdrawn.

In the rejection of claim 16, the Office action contends that the embodiment of FIG. 8 of Bullock comprises a first major layer, a second major layer, a plurality of first electrodes, a plurality of piezoelectric members, and a plurality of second electrodes, wherein the first electrodes comprise a unitary first metallic layer, the piezoelectric members comprise a unitary piezoelectric layer, and the second electrodes comprise a unitary second metallic layer. See page 3 of the Office action. Applicants believe this contention is incorrect.

As shown in FIGS. 7-9, the apparatus of Bullock comprises a block 23 that is formed with multiple cavities 16. Covering each cavity 16 is a respective transducer element 1 each having a plurality of piezoelectric bars 2 bonded to a metal support plate 3. See col. 2, lines 33-35. As best shown in FIGS. 7 and 9, each transducer 1 is separate from the other transducer elements of the block 23. Hence, the piezoelectric bars and electrodes of the transducers 1 do not (and cannot) form respective unitary layers, as required by claim 16.

Also, Bullock does not disclose the combination of features recited in claim 16 because the Bullock device at most includes one major layer (block 23). There is no teaching or suggestion in Bullock of a plurality of fluid-tight cavities formed between first and second major layers, as required by claim 16. If the Examiner disagrees, Applicants request that the Examiner point out the components in FIGS. 7-9 of Bullock that the Examiner believes correspond to the claimed first and second major layers.

For the foregoing reasons, claim 16 is not anticipated or rendered obvious by Bullock and is allowable.

Claim 17 depends from claim 16 and is allowable for the reasons given above in support of claim 16 and further because claim 17 sets forth an independently patentable combination of features.

Claim 19 is directed to a structure having a plurality of micro-transducers. The structure comprises a first major layer; a second major layer juxtaposed to the first layer; a plurality of fluid-tight cavities cooperatively formed between the first and second major layers; a working fluid contained in the cavities; a plurality of first electrodes carried by the first major layer at each of said cavities; a plurality of piezoelectric members carried by the first electrodes at each of said cavities; a plurality of second electrodes carried by the piezoelectric members at each of said cavities; and an intermediate layer disposed between the first and second layers. Bullock neither teaches nor suggests such a structure.

As noted above, the Bullock device at best includes one major layer (block 23) in which a plurality of fluid cavities are formed. But, the Bullock device does not include a first major layer, a second major layer, and an intermediate layer that form a plurality of fluid-tight cavities. Therefore, Bullock does not satisfy the limitations of claim 19.

In the rejection of claim 19, the Office action contends that the side wall 18 of the embodiment shown in FIG. 6 of Bullock is an intermediate layer 18. Even if the side wall 18 could be envisioned as being an intermediate layer (and Applicants make no such admission), this embodiment of Bullock clearly does not also include a plurality of fluid-tight cavities formed between first and second major layers, as required by claim 19.

IV. 35 U.S.C. § 102(b) Rejection of Claims 104 and 105

Claims 104 and 105 were rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 2,522,389 to Mason (Mason). Applicants traverse this rejection and request that it be withdrawn.

Claim 104 recites a micro-transducer comprising a body defining a fluid-tight cavity and a compressible and expansible working fluid contained within the cavity. The body has a piezoelectric unit situated adjacent the cavity. The piezoelectric unit is operable as an actuator to compress the working fluid whenever an electric field is applied to the piezoelectric unit and operable as a generator to generate an electric charge whenever the working fluid expands. Mason neither teaches nor suggests such a device.

Referring to the figure of Mason, the Mason device includes an explosion chamber 1 and a second chamber 16 separated from the explosion chamber by diaphragms 3 and 14. A partition 17 divides the second chamber 16 into a left-hand portion filled with water 18 and a right-hand portion filled with oil 21. See col. 2, line 7-col. 3, line 11. The right-hand portion of the second chamber also houses a plurality of piezoelectric crystal elements 23. See col. 3, lines 18-22. In use, an explosion of fuel in the explosion chamber 1 generates a pressure wave that is transferred to the piezoelectric elements 23, which are thus caused to vibrate and generate electricity. See col. 1, lines 5-10 and col. 4, lines 10-75.

In the rejection of claim 104, the Office action contends that col. 5 of Mason discloses a compressible and expansible working fluid. This portion of Mason discusses in detail the vibration of the combustion gases within the explosion chamber 1. Applicants note that combustion gases located within an explosion chamber can be compressible and expansible. For example, whenever fuel in the explosion chamber is ignited, the resulting combustion gases

expand and cause the piezoelectric elements 23 to vibrate. However, there is no disclosure in Mason that the piezoelectric elements 23 are operable also to compress the combustion gases.

Further, the explosion chamber 1 includes an exhaust pipe 12 through which the combustion gases are vented. Since the combustion gases are vented (and therefore not contained in the chamber), the piezoelectric elements 23 are not understood to compress the combustion gases in the manner instantly claimed.

Accordingly, claim 104 is not anticipated or rendered obvious by Mason and is allowable.

Claim 105 depends from claim 104 and is allowable for the reasons given above in support of claim 104 and further because claim 105 sets forth an independently patentable combination of features.

V. 35 U.S.C. § 103(a) Rejection of Claim 20

Claim 20 was rejected under 35 U.S.C. § 103(a) as allegedly being obvious from Bullock in view of U.S. Patent No. 4,651,042 to Nakamura et al. (Nakamura). Applicants traverse this rejection and request that it be withdrawn.

Claim 20 depends from claim 19 and is allowable for the reasons given above in support of claim 19 and further because claim 20 sets forth an independently patentable combination of features. In particular, neither Bullock nor Nakamura, taken alone or together, teaches or suggests a structure having an intermediate layer comprising photo-resist material.

Nakamura discloses a method for forming a piezoelectric vibrator. The method includes forming a photo-resist mask on a substrate to protect selected portions of the substrate during an etching process. See col. 3, lines 52-68 and col. 4, lines 14-25. After the substrate is removed

from an etching solution, the photo-resist mask is removed and thus does not remain a part of the finished piezoelectric vibrator. See FIGS. 5E and 6D and col. 4, lines 21 and 22.

The structure recited in claim 20 is substantially different from the Nakamura devices because the structure of claim 20 includes a layer of photo-resist as part of the finished structure. In Nakamura, in contrast, photo-resist is simply used as a mask to prevent etching of selected portions of the substrate: the mask is removed after etching and thus does not form a part of the finished product.

VI. 35 U.S.C. § 103(a) Rejection of Claim 106 and 107

Claims 106 and 107 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious from Bullock in view of Mason. Applicants traverse this rejection and request that it be withdrawn.

Claims 106 and 107 depend from claim 104 and are allowable for the reasons given above in support of claim 104 and further because each dependent claim sets forth a respective independently patentable combination of features.

For example, claim 106 is directed to a micro-transducer comprising a body defining a fluid-tight cavity and a compressible and expansible working fluid contained within the cavity. The body has a piezoelectric unit situated adjacent the cavity. The piezoelectric unit is operable as an actuator to compress the working fluid whenever an electric field is applied to the piezoelectric unit and operable as a generator to generate an electric charge whenever the working fluid expands. Claim 106 also requires that the body comprise a first membrane and a second membrane, that the cavity be formed between the membranes, and that the piezoelectric

unit be disposed on the first membrane. Neither Bullock nor Mason (either alone or in combination) teaches or suggests such a combination of features.¹

Bullock, as presently understood, does not teach or suggest a compressible and expansible working fluid contained in a cavity or a piezoelectric unit that is operable as an actuator to compress the working fluid whenever an electric field is applied to the piezoelectric unit and operable as a generator to generate an electric charge whenever the working fluid expands. Mason does not make up for these deficiencies of Bullock. For example, as noted above, there is no disclosure in Mason that the piezoelectric elements 23 are operable to compress a working fluid in the device. Additionally, Mason's piezoelectric elements 23 are housed in an oil-filled cavity. As is well known, oil is not compressible.

Claim 107, which depends from claim 106, further recites that the first membrane is more flexible than the second membrane. The Office action contends that the Bullock device satisfies this claim limitation because the Bullock device includes a rubber membrane and a membrane comprising a piezoelectric element, electrodes, and a metal support. See page 5 of the Office action. Even if the rubber membrane in the Bullock device were more flexible than the membrane containing the piezoelectric element and the metal support, Bullock still does not meet the limitations of claim 107 because in the claimed device the membrane that supports the piezoelectric unit (the first membrane) is more flexible than the other membrane.

¹ Although unclear in the Office action, Applicants assume that the Examiner is relying on Bullock as the primary reference and Mason as the secondary reference in the rejection of claim 106 and 107. Applicants request clarification of the rejection if this assumption is not correct.

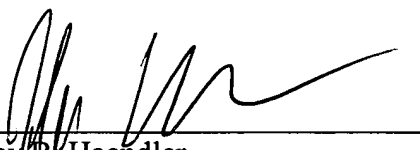
VII. Conclusion

The present application is in condition for allowance and such action is respectfully requested. If any further issues remain concerning this application, the Examiner is requested to call the undersigned to discuss such matters.

Respectfully submitted,

KLARQUIST SPARKMAN, LLP

By



Jeffrey B. Haendler
Registration No. 43,652

One World Trade Center, Suite 1600
121 S.W. Salmon Street
Portland, Oregon 97204
Telephone: (503) 226-7391
Facsimile: (503) 228-9446